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(54) **BALANCER AND WASHING MACHINE**

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D06F 37/30 (2020.01)

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(58) **Field of Classification Search**

CPC D06F 33/48
See application file for complete search history.

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(57) **ABSTRACT**

The present invention relates to a balancer and a washing machine including the same. The balancer includes at least two drive modules which provide a driving force; at least two gear rails having a ring shape which are gear-coupled to each of the drive modules and rotated; at least two balancing weights which move along a circumference of a drum by the rotation of each of the gear rails and change a center of gravity of the drum; a reception coil which generates power from a magnetic field formed by a transmission coil; and a guide case which accommodates at least the reception coil and the drive modules.

20 Claims, 8 Drawing Sheets

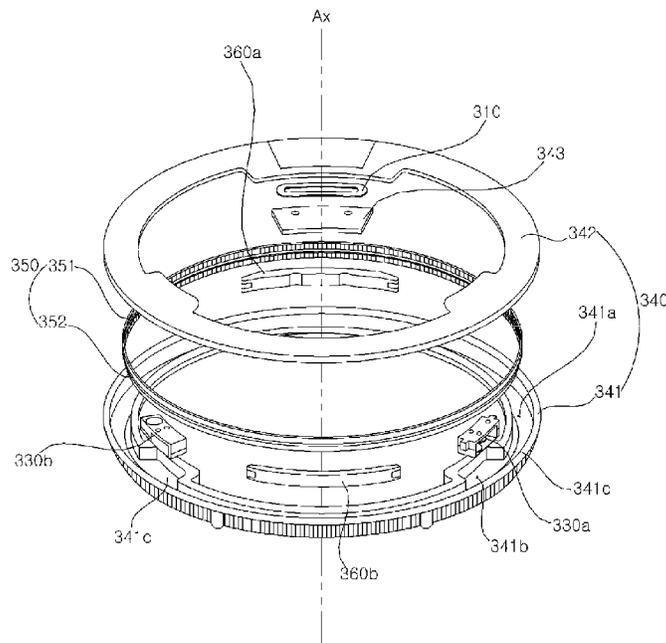


FIG. 1A

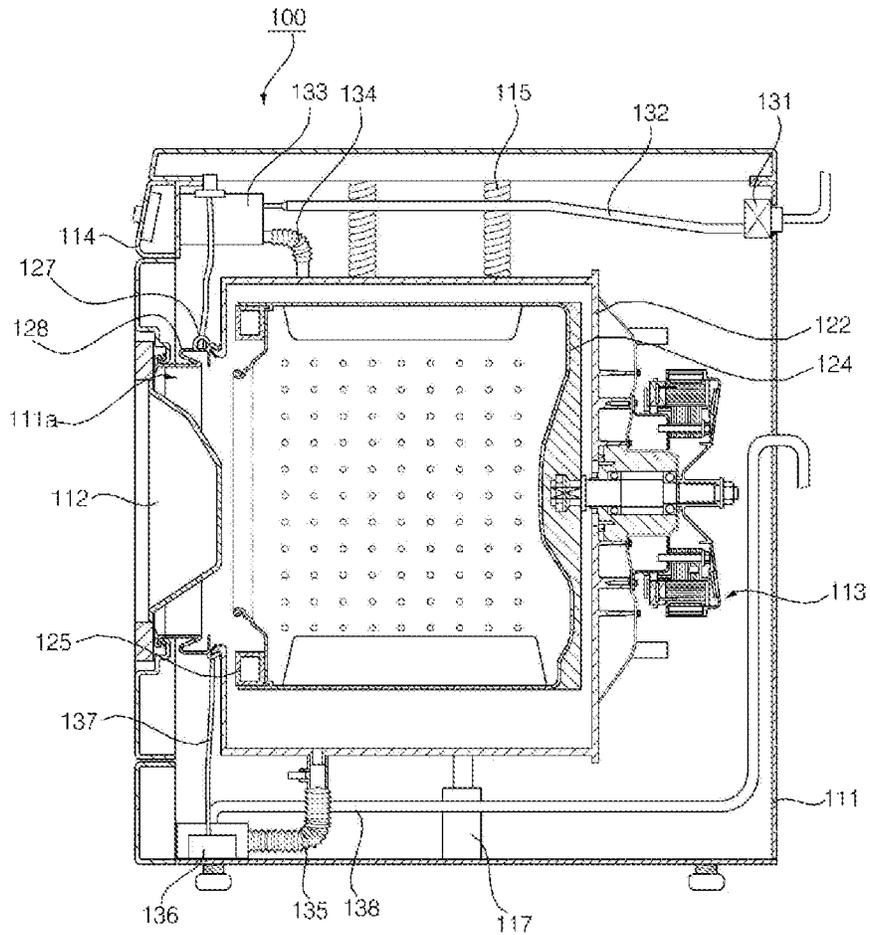


FIG. 1B

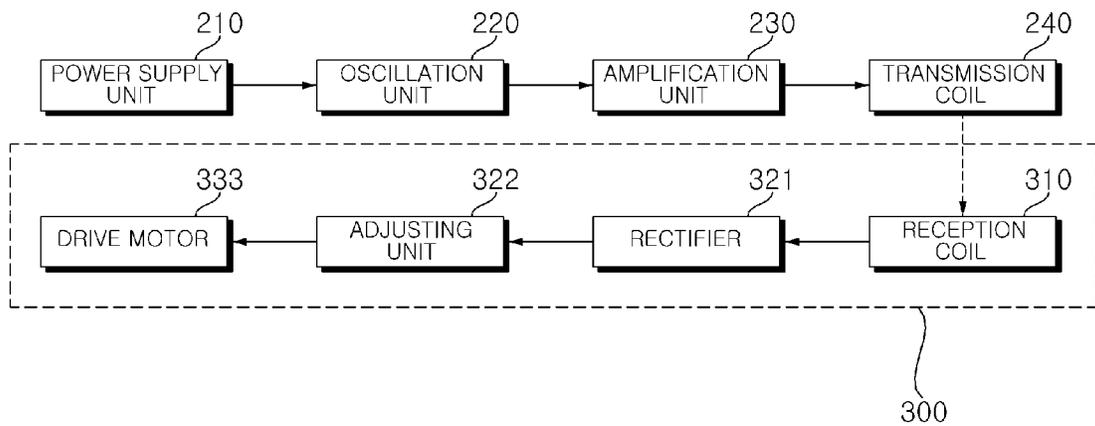


FIG. 2

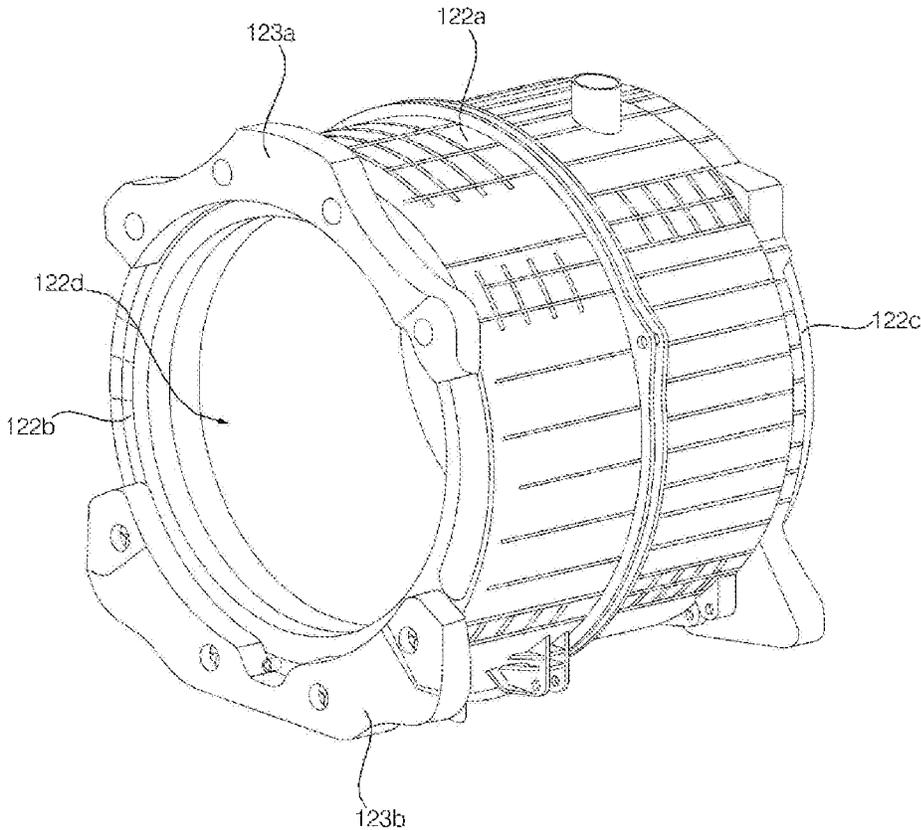


FIG. 3

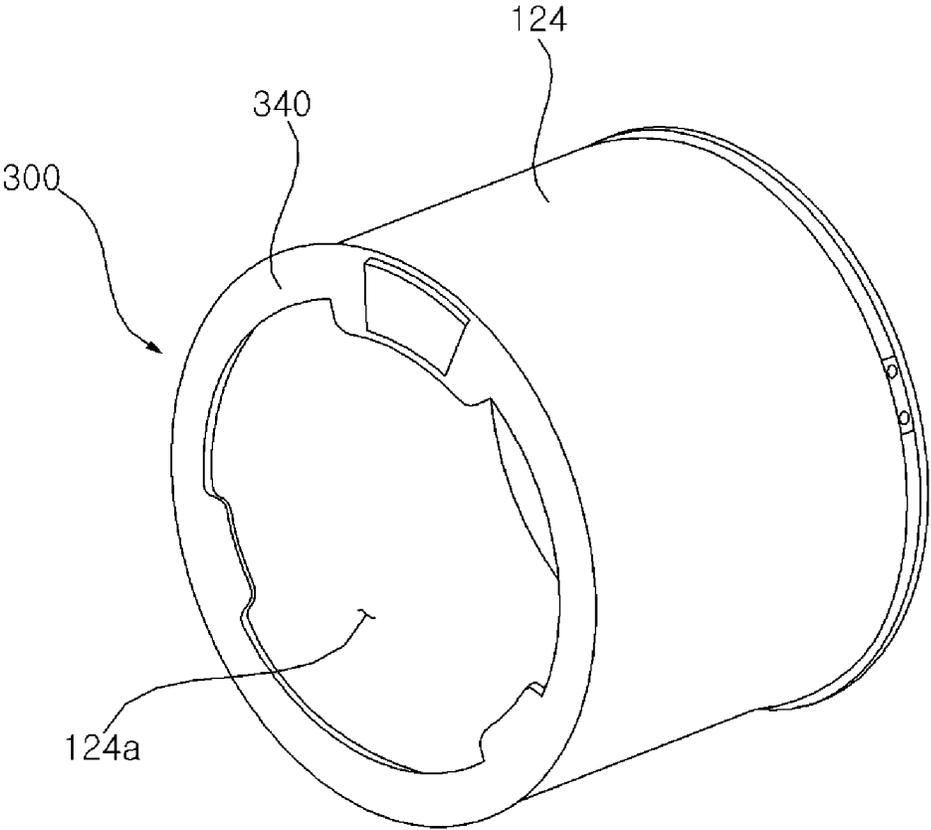


FIG. 4

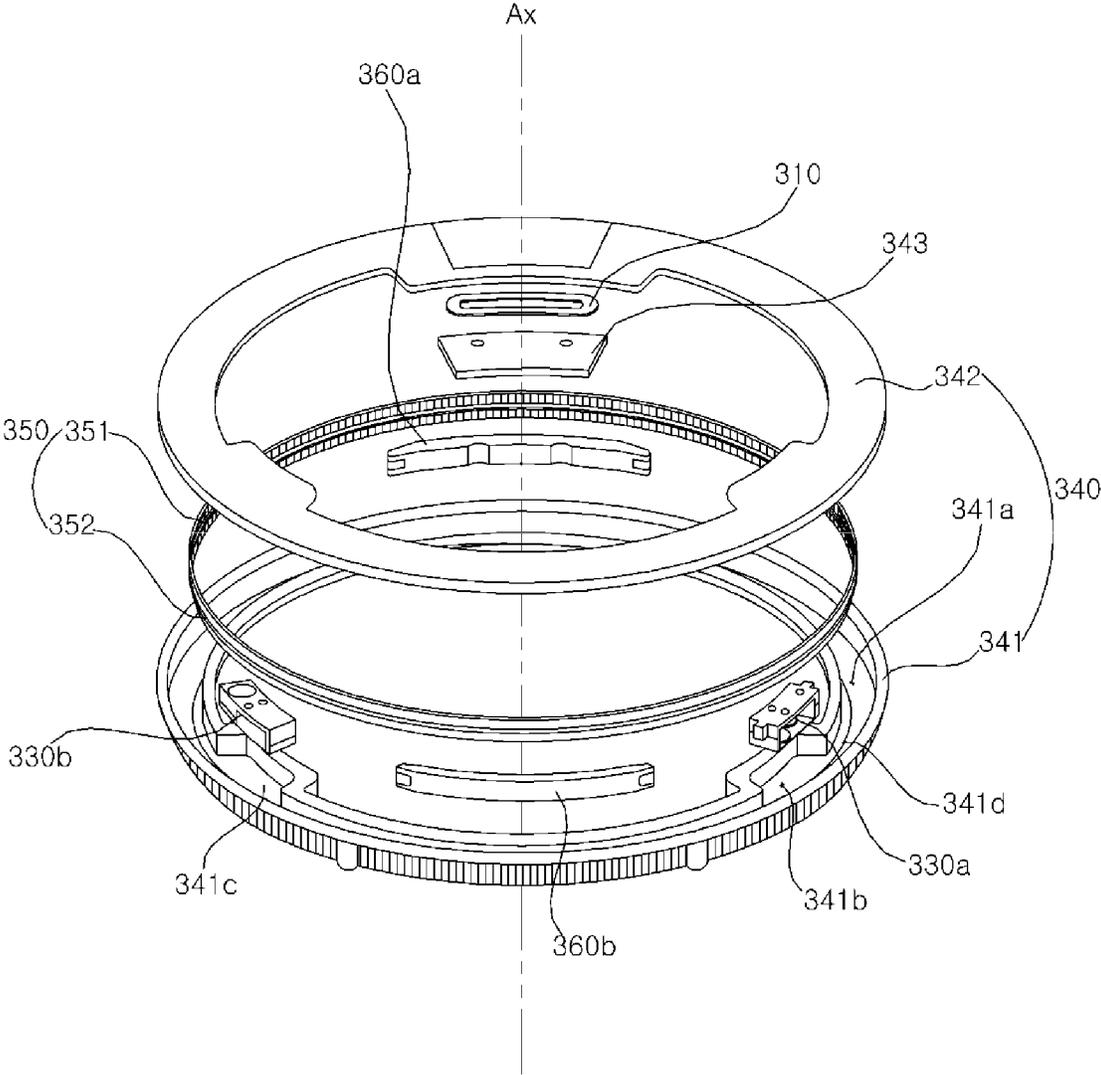


FIG. 5

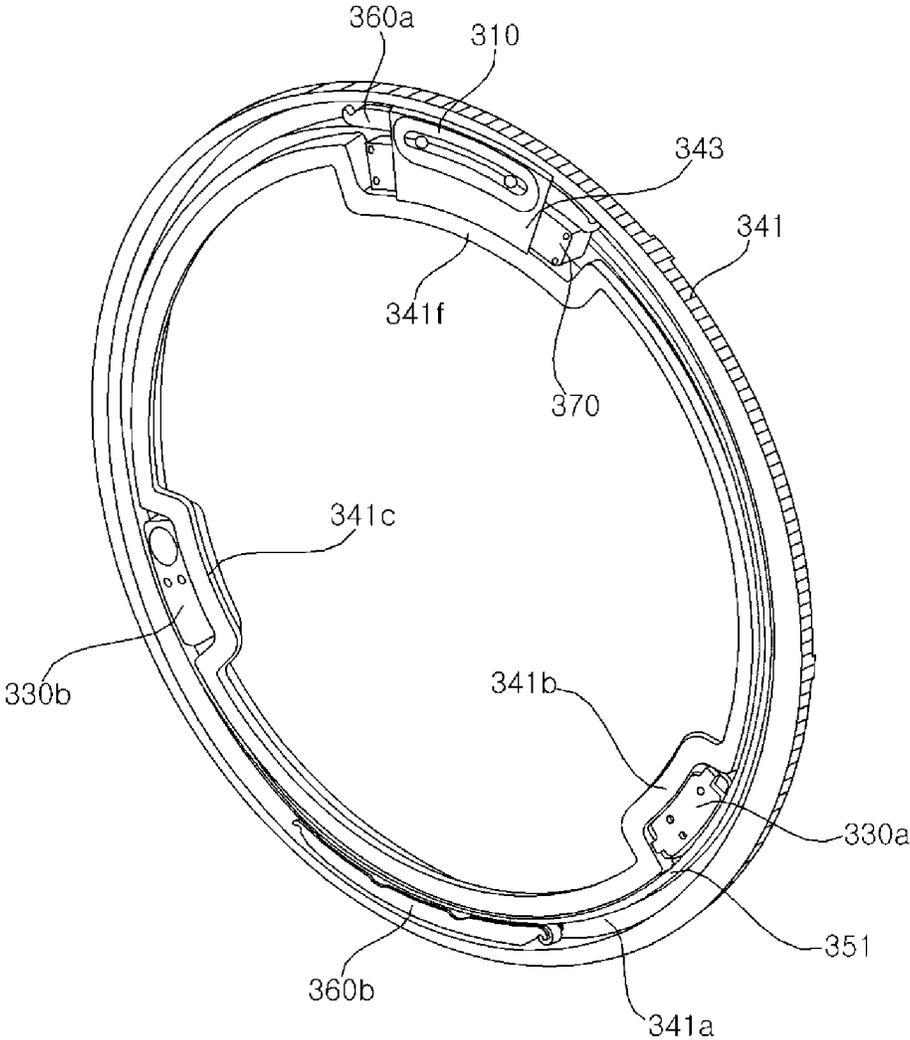


FIG. 7

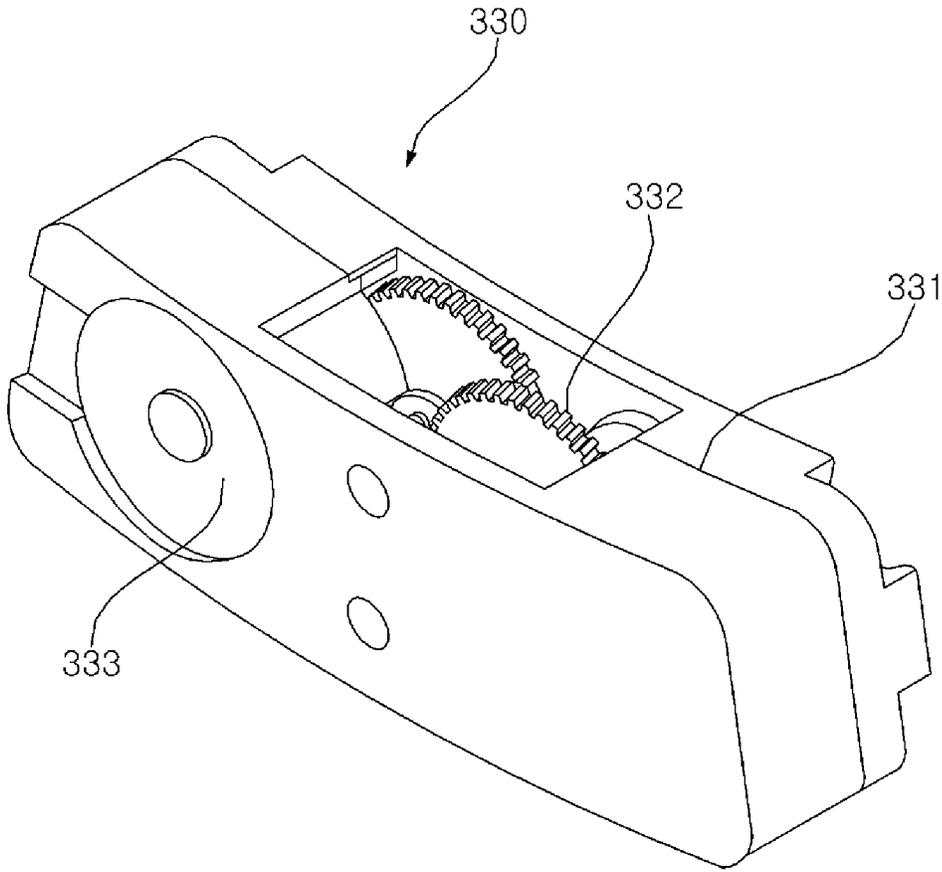
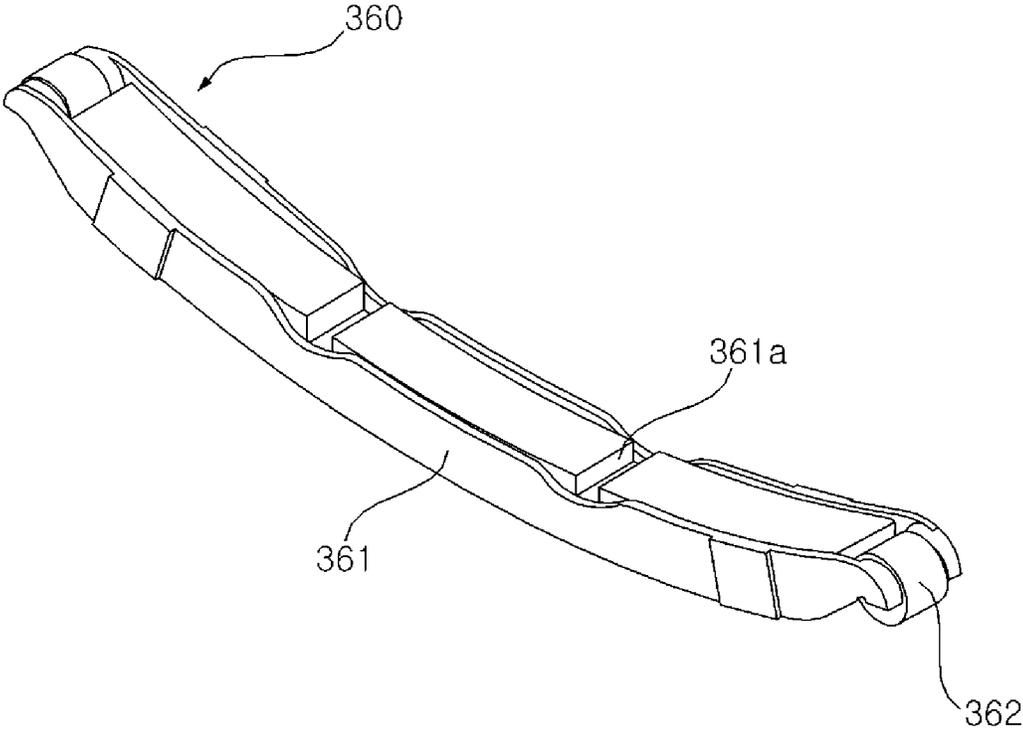


FIG. 8



BALANCER AND WASHING MACHINECROSS-REFERENCE TO RELATED
APPLICATION

This application claims the benefit of priority to Korean Application No. 10-2018-0123767, filed on Oct. 17, 2018. The disclosure of the prior application is incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a balancer that is actively movable and a washing machine equipped with a balancer.

2. Description of the Related Art

In general, a washing machine is an apparatus that performs cleaning through a process such as washing, rinsing, dehydrating, and the like to remove contamination on clothes, bedding, etc. (hereinafter, referred to as 'cloth') by using water, detergent, and mechanical action.

Washing machines are classified into agitator type, pulsator type, and drum type washing machines.

The agitator type washing machine performs washing by rotating a laundry rod towering in the center of the washing tub from side to side, the pulsator type washing machine rotates a disk-shaped rotary blades formed in the lower portion of the washing tub from side to side to perform washing by using frictional force between the water flow and the cloth, and the drum type washing machine performs washing by putting water, detergent, and cloth into the drum, and rotating the drum.

The drum washing machine is provided with a tub, a drum, a motor, and a drive shaft. The tub, in which washing water is accommodated, is provided inside a cabinet forming an outer shape. The drum, which accommodates a cloth, is disposed inside the tub. The motor is mounted in the rear surface side of the tub so as to rotate the drum. The drive shaft which penetrates through the motor and is connected to the rear surface side of is built up in the drum. The inside of the drum is equipped with a lifter to lift the cloth when the drum rotates.

Such a washing machine has a phenomenon in which the cloth is biased to one side due to the entanglement of the cloth, which causes an eccentricity in which one side becomes heavy based on the center of the drum. When the cloth is eccentric and the drum rotates at high speed (e.g., when the cloth is dehydrated), vibration and noise are generated by unbalance where the geometric center of the drum's rotation axis itself and the actual center of gravity are not coincident. An apparatus, which is called a balancer, for reducing the unbalance of the drum is installed in order to reduce such vibration and noise.

A counter weight for counterbalancing eccentricity by attaching additional mass has been used as a balancer for drum type washing machines. Recently, as shown in Korean Utility Model Publication No. 1998-019360, a ball balancer that has a ring-shaped space, which is formed in the front surface or rear surface of the drum, having a certain width in the circumferential direction, inserts a ball therein, and then, fills liquid to completely seal by heat-welding is mainly employed. When the drum rotates at high speed, the balancer distributes the inner material to move away from

the center of gravity of the cloth so that the center of gravity of the drum approaches the center of rotation.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above problems, and provides a balancer and a washing machine which actively move to actively eliminate an unbalance.

The present invention further provides a balancer and a washing machine which can operate by wireless power, have a simple structure, and can reduce the number of parts.

The present invention further provides a balancer and a washing machine which do not exert an influence on the center of gravity of the drum while disposing a reception coil and a drive module in a guide case.

In order to achieve the above object, the present invention includes: a tub which accommodates washing water, and has a transmission coil generating a wireless power signal and transmitting power wirelessly; a drum having a cylindrical shape which is disposed inside the tub, accommodates a cloth, and is rotatable; and a balancer which reduces unbalance generated by a bias of the cloth when the drum is rotated, wherein the balancer includes: at least two drive modules which provide a driving force; at least two gear rails having a ring shape which are gear-coupled to each of the drive modules and rotated; at least two balancing weights which move along a circumference of the drum by the rotation of each of the gear rails and change a center of gravity of the drum; a reception coil which generates power from a magnetic field formed by the transmission coil; and a guide case which accommodates at least the reception coil and the drive modules.

The drive modules include a first drive module and a second drive module, wherein the reception coil and the first and second drive modules are spaced apart from each other on an arbitrary circumference around a rotation axis of the drum, and a separation distance between the reception coil and the first drive module is the same as a separation distance between the reception coil and the second drive module.

The drive modules include a first drive module and a second drive module, wherein the reception coil and the first and second drive modules are spaced apart from each other on an arbitrary circumference around a rotation axis of the drum, and a center angle between the reception coil and the first drive module is the same as a center angle between the reception coil and the second drive module.

The balancer further includes a circuit board which transmits power of the reception coil to the drive modules and generate a control signal for controlling the drive module, wherein the circuit board is accommodated in the guide case.

At least a part of the circuit board and the reception coil is disposed to overlap in a direction of rotation axis of the drum.

The guide case includes a guide part for defining a path through which the balancing weight is moved.

The guide part has a ring shape.

The guide case includes a drive module accommodating part which is extended from the guide part in a direction of rotation axis of the drum and accommodates each of the drive modules.

The guide case further includes a receiver accommodating part which is extended from the guide part in a direction of rotational axis of the drum to place the reception coil.

The balancer further includes a circuit board which transmits power of the reception coil to the drive modules, and

generates a control signal for controlling the drive modules, wherein the circuit board is accommodated in the receiver accommodating part.

The drive module includes: a drive motor; and a pinion gear which is engaged with the drive motor and each of the gear rails.

The gear rail includes: a rail body having a ring shape; a rack gear formed in an inner circumferential surface of the rail body; and a protrusion which is protruded from an outer circumferential surface of the rail body and restrains the balancing weight.

The two gear rails are positioned at different heights.

The balancing weight includes: a balancing body which has a coupling groove coupled to the gear rail; and a roller coupled to the balancing body.

Each of the drive modules is positioned inside a circumference formed by the gear rail, and each of the balancing weights is positioned outside the circumference formed by the gear rail.

In accordance with another aspect of the present invention, a balancer includes: at least two drive modules which provide a driving force; at least two gear rails having a ring shape which are gear-coupled to each of the drive modules and rotated; at least two balancing weights which move along a circumference of a drum by the rotation of each of the gear rails and change a center of gravity of the drum; a reception coil which generates power from a magnetic field formed by a transmission coil; and a guide case which accommodates at least the reception coil and the drive modules.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1A is a cross-sectional view of a washing machine according to an embodiment of the present invention;

FIG. 1B is a block diagram of the washing machine shown in FIG. 1A;

FIG. 2 is a perspective view of a tub of the washing machine shown in FIGS. 1A and 1B;

FIG. 3 is a perspective view of a drum of the washing machine shown in FIGS. 1A and 1B and a balancer installed in the drum;

FIG. 4 is an exploded perspective view of a balancer according to an embodiment of the present invention;

FIG. 5 is a perspective view of a balancer according to an embodiment of the present invention;

FIG. 6 is a plan view of a balancer according to an embodiment of the present invention;

FIG. 7 is a perspective view of a drive module according to an embodiment of the present invention; and

FIG. 8 is a perspective view of a balancing weight according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Exemplary embodiments of the present invention are described with reference to the accompanying drawings in detail. The same reference numbers are used throughout the drawings to refer to the same or like parts. Detailed descriptions of well-known functions and structures incorporated herein may be omitted to avoid obscuring the subject matter of the present invention. As used herein, the singular form is

intended to include the plural forms as well, unless the context clearly indicates otherwise. In the present application, it will be further understood that the terms "comprises", "includes," etc. specify the presence of stated features, integers, steps, operations, elements, components, or combinations thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, or combinations thereof. Unless defined otherwise, the terms including technical and scientific terms used in this specification may have the meaning that can be commonly apprehended by those skilled in the art. The terms, such as the terms defined in the commonly-used dictionary, must be interpreted based on the context of the related technology and must not be interpreted ideally or excessively.

Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings.

FIG. 1A is a cross-sectional view of a washing machine according to an embodiment of the present invention, FIG. 1B is a block diagram of the washing machine shown in FIG. 1A, FIG. 2 is a perspective view of a tub of the washing machine shown in FIGS. 1A and 1B, and FIG. 3 is a perspective view of a drum of the washing machine shown in FIGS. 1A and 1B and a balancer installed in the drum.

A washing machine **100** according to an embodiment of the present invention includes a cabinet **111** which forms an outer shape, a door **112** which opens and closes one side of the cabinet to allow the cloth to enter and exit the cabinet, a tub **122** disposed inside the cabinet and supported by the cabinet, a drum **124** disposed inside the tub and rotating with a cloth inserted therein, a drum motor **113** which rotates the drum by applying torque to the drum, a detergent box **133** which accommodates detergent, and a control panel **114** which receives a user input and displays a washing machine state.

The cabinet **111** has a cloth loading hole **111a** formed to allow the cloth to enter and exit. The door **112** is rotatably coupled to the cabinet **111** to allow the cloth loading hole **111a** to be opened and closed. The cabinet **111** is provided with the control panel **114**. The cabinet **111** is provided with a detergent box **133** to be withdrawn.

The tub **122** is disposed in the cabinet **111** to be buffered by a spring **115** and a damper **117**. The tub **122** accommodates washing water. The tub **122** is disposed in the outside of the drum **124** while surrounding the drum **124**.

The tub **122** includes a cylindrical tub body **122a** having both sides opened, a ring-shaped front tub cover **122b** disposed in an opened front side of the tub body **122a**, and a disk-shaped rear tub cover **122c** disposed in an opened rear side of the tub body **122a**. Hereinafter, the front side means the door **112** side, and the rear side means the drum motor **113** side.

A tub hole **122d** is formed in one side of the tub **122**. The tub hole **122d** is formed to communicate with the cloth loading hole **111a** to allow the cloth to enter and exit the drum **124**. The tub hole **122d** is formed in the front tub cover **122b**.

A weight **123** is coupled to a portion of one side edge of the tub **122**. The weight **123** applies a load to the tub **122**. The weight **123** is preferably disposed around the tub hole **122d**. A plurality of weights **123** may be provided, and disposed in a portion of upper side and lower side of the front tub cover **122b**.

The plurality of weights **123** includes an upper weight **123a** disposed above the front tub cover **122b** and a lower weight **123b** disposed below the front tub cover **122b**. The

upper weight **123a** is disposed above the tub hole **122d** among the edge of the tub **122**, and the lower weight **123b** is disposed below the tub hole **122d** among the edge of the tub **122**.

A transmission coil **240** described later may be disposed in the edge of one side of the tub **122**. The transmission coil **240** wirelessly supplies power to the balancer **300**.

The drum motor **113** generates a rotational force. The drum motor **113** may rotate the drum **124** at various speeds or directions. The drum motor **113** includes a stator (not shown) wound around with a coil, and a rotor (not shown) that rotates by generating electromagnetic interaction with the coil.

The drum **124** accommodates the cloth and is rotated. The drum **124** is disposed inside the tub **122**. The drum **124** is formed in a rotatable cylindrical shape. The drum **124** is provided with a plurality of through holes so that the washing water can pass. The drum **124** rotates while receiving the rotational force of the drum motor **113**.

A drum hole **124a** is formed in the front side of the drum **124**. The drum hole **124a** is formed to communicate with the cloth loading hole **111a** and the tub hole **122d** so that the cloth can be loaded into the drum **124**.

The balancer is coupled to the edge of one side of the drum **124**. The balancer reduces the unbalance generated by the biasing of the cloth when the drum rotates.

A gasket **128** seals between the tub **122** and the cabinet **111**. The gasket **128** is disposed between the opening of the tub **122** and the cloth loading hole **111a**. The gasket **128** mitigates the shock transmitted to the door **112** when the drum **124** rotates, while preventing the washing water in the tub **122** from leaking to the outside. The gasket **128** may be provided with a circulation nozzle **127** for introducing washing water into the drum **124**.

The detergent box **133** accommodates a detergent such as laundry detergent, fabric softener or bleach. The detergent box **133** is preferably provided in the front surface of the cabinet **111** to be withdrawn. The detergent in the detergent box **133** is mixed with the washing water when the washing water is supplied, and introduced into the tub **122**.

It is preferable that a water supply valve **131** for controlling the inflow of the washing water from an external water source, a water supply flow path **132** through which the washing water introduced into the water supply valve flows into the detergent box **133**, and a water supply pipe **134** for introducing washing water mixed with detergent in the detergent box **133** into the tub **122** are provided inside the cabinet **111**.

It is preferable that a drain pipe **135** through which the washing water in the tub **122** is discharged, a pump **136** for discharging the washing water in the tub, a circulation flow path **137** for circulating the washing water, a circulation nozzle **127** for introducing the washing water into the drum **124**, and a drain flow path **138** for draining the washing water to the outside are provided inside the cabinet **111**. According to an embodiment, the pump **136** may be provided with a circulation pump and a drain pump, and may be connected to the circulation flow path **137** and the drain flow path **138**, respectively.

The balancer **300** is provided in the front side and/or rear side of the drum **124** and, in the present embodiment, is coupled to the edge of the front side of the drum **124**. The balancer **300** is preferably disposed around the drum hole **124a**.

The balancer **300** moves along the edge of the drum **124** and changes the center of gravity of the drum **124**. In this case, the center of gravity of the drum **124** does not mean the

center of gravity of the drum **124** itself, but means a common center of gravity of objects including the drum **124**, the cloth accommodated in the drum **124**, the balancer **300**, and components attached to the drum **124** that rotate together with the drum **124** when the drum **124** rotates.

The balancer **300** moves along the circumferential direction of the drum **124** to adjust the center of gravity of the drum **124** when the cloth is eccentric. When the drum **124** rotates while the cloth is eccentric, vibration and noise are generated due to unbalance in which the geometric center of a rotation axis Ax itself and the actual center of gravity of the drum **124** are not coincident. The balancer **300** reduces the unbalance of the drum **124** by allowing the center of gravity of the drum **124** to approach the rotation axis Ax.

The control panel **114** may include an input unit (not shown) for receiving various operation commands such as a washing course selection, an operation time and reservation for each process through a user, and a display unit (not shown) for displaying the operation state of the washing machine **100**.

Referring to FIG. 1B, the washing machine according to an embodiment of the present invention includes a power supply unit **210** for supplying electric power from the outside, an oscillation unit **220** for generating a voltage fluctuation range in the power supplied from the power supply unit **210**, an amplification unit **230** for amplifying the power, a transmission coil **240** for generating a magnetic field, a reception coil **310** for generating power due to electromagnetic induction from a magnetic field, a rectifier **321** for converting a power generated in the reception coil **310** into a direct power, an adjusting unit **322** for adjusting the power into a certain voltage and current, and a drive motor **330** for generating power.

The power supply unit **210** converts commercial power, which is AC supplied from the outside, into an appropriate power. In the present embodiment, the power supply unit is a switched-mode power supply to convert the commercial power into 14V DC. The power supply unit **210** may be provided in a certain position inside the cabinet **111** or in the control panel **114**. The power converted and supplied by the power supply unit **210** may also be supplied to the drum motor **113**.

The oscillation unit **220** is an oscillator, and generates a voltage fluctuation range in the power supplied from the power supply unit **210** to generate a magnetic field in the transmission coil **240**. The amplifier **230** amplifies the power so that the transmission coil **240** can acquire a sufficient current.

The transmission coil **240** generates a magnetic field, and the reception coil **310** generates power due to electromagnetic induction from the magnetic field which the transmission coil **240** generated.

The rectifier **321** converts the power generated from the reception coil **310** into DC power. The adjusting unit **322** adjusts the power rectified by the rectifier **321** into a certain voltage and current.

The drive motor **330** generates power from the power adjusted by the adjusting unit **322**. The drive motor **330** generate power from the power that is supplied from the outside and transmitted wirelessly through the transmission coil **240** and the reception coil **310**. Generally, the adjusting unit **322** and the rectifier **321** are disposed in a circuit board **370** described later.

According to an embodiment, a storage unit (not shown) for temporarily storing the power adjusted by the adjusting unit **322** may be provided, and the storage unit (not shown) may be configured of a capacitor or a battery.

The above-mentioned oscillation unit **220** and amplifier **230** are preferably provided in a certain position inside the cabinet **111** or in the control panel **114**, and the reception coil **310**, the rectifier **321**, the adjusting unit **322**, and the drive motor **330** are preferably included in the balancer **300**.

The transmission coil **240** is disposed in the edge of one side of the tub **122** as described above.

The transmission coil **240** is disposed in the tub **122** to correspond to the movement path of the balancer **300** and wirelessly supplies power to the balancer **300**. The transmission coil **240** may be disposed in the tub **122** in correspondence with a guide case **340** described later.

The transmission coil **240** may be formed in an arc shape and disposed in a portion of one side edge of the tub **122**, or may be formed in a ring shape and disposed in the entire of one side edge of the tub **122**. The transmission coil **240** is preferably disposed around the tub hole **122d** which is an edge of the front side of the tub **122**.

The transmission coil **240** may be disposed in the front tub cover **122b** or the rear tub cover **122c**. In the present embodiment, the transmission coil **240** is disposed in the front tub cover **122b**. The transmission coil **240** is preferably disposed in the front side of the front tub cover **122b** to face a guide rail **125**.

The tub **122** is preferably coupled to a coil cover (not shown) surrounding the transmission coil **240**. The coil cover (not shown) is coupled to the front tub cover **122b** to surround the transmission coil **240**. The coil cover (not shown) protects the transmission coil **240** from water or foreign matter together with the front tub cover **122b**.

The transmission coil **240** is preferably disposed in the front tub cover **122b** in correspondence with the balancer **300**. The reception coil **310** is provided in one side of the balancer **300** and the transmission coil **240** is disposed to correspond to the reception coil **310**. The transmission coil **240** is disposed in a portion of the moving path of the reception coil **310** to allow the magnetic field generated in the transmission coil **240** to be converted into power in the reception coil **310**.

It is preferable that the distance between the transmission coil **240** and the reception coil **310** maintains a distance in which power can be transmitted wirelessly. The distance between the transmission coil **240** and the reception coil **310** is preferably within 30 mm.

When a plurality of balancers **300** are provided, a plurality of transmission coils **240** may be provided.

Referring to FIG. 2, the weight **123** is coupled to a portion of the edge of the drum **124**. The transmission coil **240** is preferably disposed in an area where the weight **123** is not disposed among the edge of one side of the tub **122**. At this time, the transmission coil **240** is preferably formed in an arc shape.

A plurality of weights **123** are provided and disposed in a portion of the upper and lower sides of the front tub cover **122b**. A plurality of transmission coils **240** are provided in both sides of the front tub cover **122b** between the upper weight **123a** and the lower weight **123b**.

FIG. 4 is an exploded perspective view of a balancer **300** according to an embodiment of the present invention, FIG. 5 is a perspective view of a balancer **300** according to an embodiment of the present invention, FIG. 6 is a plan view of a balancer **300** according to an embodiment of the present invention, FIG. 7 is a perspective view of a drive module **300** according to an embodiment of the present invention, and FIG. 8 is a perspective view of a balancing weight **300** according to an embodiment of the present invention.

Hereinafter, referring to FIGS. 4 to 8, the balancer **300** will be described in detail.

The balancer **300** may further include at least two drive modules **330** which provide driving force, at least two gear rails **350** which have a ring shape and are rotated while being gear-coupled with each drive module **330**, at least two balancing weights **360** which move along the circumference of the drum **124** due to rotation of each gear rail **350** and change the center of gravity of the drum **124**, a reception coil **310** which generates power from a magnetic field formed by the transmission coil, and a guide case **340** for accommodating at least the reception coil **310** and the drive modules **330**.

The guide case **340** accommodates at least reception coil **310** and drive module **330**. Preferably, the guide case **340** may accommodate a circuit board **370** described later, a balancing weight **360**, and a gear rail **350**. The guide case **340** may be provided in the front side and/or rear side of the drum **124**, and in the present embodiment, the guide case **340** is provided in the front side of the drum **124**. When the drum **124** is rotated, the cloth accommodated in the drum **124** is generally collected in the inner side of the drum **124**, i.e., in the rear side. Accordingly, it is preferable that the guide case **340** is provided in the front side of the drum **124** so as to be balanced with the cloth collected in the rear side of the drum **124**.

According to the present invention, the drive module **330** and the circuit board **370** are not integrally formed with the balancing weight **360**, but separately fixed to the guide case **340**, so that the drive module **330** and the circuit board **370** do not move when the balancing weight **360** is moved, thereby reducing damage occurred during movement.

The guide case **340** has a ring shape corresponding to the circumference of the drum **124**, and may have a space in which the balancing weight **360** moves along the circumference of the drum **124**, a space for accommodating the drive module **330** and the reception coil **310**, and a space for accommodating the gear rail **350**.

In detail, the guide case **340** may include a case body **341** and a case cover **342** covering the case body **341**.

The case body **341** is provided with a guide part **341a** which is a path through which the balancing weight **360** passes. The guide part **341a** is formed in such a manner that a cross section of the case body **341** is recessed downward so that the balancing weight **360** is movable therein. The guide part **341a** may have a ring shape corresponding to the circumference of the drum **124** so as to guide a path along which the balancing weight **360** moves.

The guide case **340** may further include a drive module accommodating part **341b** and **341c** extended from the guide part **341a** in the direction of the rotation axis Ax of the drum **124** to accommodate each drive module **330**. The drive module accommodating part **341b** and **341c** may be formed in such a manner that a portion of the case body **341** is recessed in the downward direction. In detail, the drive module accommodating part **341b** and **341c** may be defined as a recessed area communicating with the guide part **341a**.

The guide case **340** may further include a receiver accommodating part **341f** extended from the guide part **341a** in the direction of the rotation axis Ax of the drum **124** to place the reception coil **310**. The receiver accommodating part **341f** may be formed in such a manner that a portion of the case body **341** is recessed in the downward direction. In detail, the receiver accommodating part **341f** may be defined as a recessed area communicating with the guide part **341a**.

Obviously, the reception coil **310** may be accommodated directly in the receiver accommodating part **341f**, or a base

board may be installed in the receiver accommodating part **341f**, and the reception coil **310** may be installed in the base board.

The guide case **340** may further include a rail accommodating part **341d** that is extended from the guide part **341a** in the direction of the rotation axis Ax of the drum **124** so that the reception coil **310** can be positioned. The rail accommodating part **341d** may be formed in such a manner that a portion of the case body **341** is recessed in the downward direction. Specifically, the rail accommodating part **341d** may be defined as a recessed area communicating with the guide part **341a**.

The rail accommodating part **341d** may be positioned inside the guide part **341a**, and the drive module accommodating parts **341b** and **341c** and the receiver accommodating part **341f** may be positioned to be spaced apart from each other inside the rail accommodating part **341d**.

The balancer **300** may further include the circuit board **370** which transmits the power of the reception coil **310** to the drive modules **330** and generates a control signal for controlling the drive module **330**.

According to the present invention, the manufacturing cost can be reduced by controlling the two drive modules **330** based on a single circuit board **370**, and the circuit board **370** does not move together with the balancing weight **360**, thereby improving reliability. The circuit board **370** is accommodated in the guide case **340**. Specifically, it is accommodated in the receiver accommodating part **341f** of the guide case **340**.

It is preferable that at least a portion of the circuit board **370** and the reception coil **310** is disposed to overlap with each other in the rotation axis Ax direction of the drum **124**. This is because the power generated by the reception coil **310** is transmitted to the circuit board **370** in the shortest distance, thereby reducing the manufacturing cost.

The drive module **330** provides a driving force. The number of drive modules **330** corresponds to the number of balancing weights **360**. In detail, the drive module **330** may include a first drive module **330a** and a second drive module **330b**.

Each drive module **330** may include a drive motor **333**, a pinion gear **332** engaged with the drive motor **333** and each gear rail **350**, and a motor housing **331** for accommodating the drive motor **333** and the pinion gear **332**.

The drive motor **333** generates a driving force from the power which is supplied from the outside and transmitted wirelessly through the transmission coil **240** and the reception coil **310**. The drive motor **333** is preferably a motor that generates a rotational force. When the drive motor **333** is a motor, a worm gear is disposed between the motor and the pinion gear **332** and the rotational force of the motor changes the axis of the motor to rotate the pinion gear **332**.

The pinion gear **332** is rotated by receiving power from the drive motor **333**. A rack gear **351b** is disposed in the inner circumferential surface of the gear rail **350**, and the pinion gear **332** meshes with the rack gear **351b** and **125a**.

The pinion gear **332** rotates while engaging with the rack gear **351b** and **125a** to rotate the gear rail **350**, and when the gear rail **350** rotates, the balancing weight **360** restrained to the gear rail **350** is moved.

The pinion gear **332** is engaged with the rack gears **351b** and **125a** to prevent the balancing weight **360** from moving by its own weight or by centrifugal force when the drum **124** rotates.

The motor housing **331** accommodates the pinion gear and the drive motor **333** and is fixed to the guide case **340**.

The motor housing **331** is fixed to the drive module accommodating part **341b** and **341c**.

When the reception coil **310** and the first and second drive modules **330** are disposed to be biased toward one side of the guide case **340**, it may cause unbalance of the drum **124**. Accordingly, it is preferable that the reception coil **310** and the first and second drive modules **330** are disposed in consideration of the balance of the center of gravity of the drum **124**.

For example, the reception coil **310** and the first and second drive module **330** are spaced apart from each other on an arbitrary circumference around the axis of rotation Ax of the drum **124**, and the separation distance between the reception coil **310** and the first drive module **330a** may be the same as the separation distance between the reception coil **310** and the second drive module **330b**. This is because the weight of the first drive module **330a** and the second drive module **330b** and the weight of the reception coil **310** are different.

Preferably, the reception coil **310** and the first and second drive modules **330** are spaced apart from each other on an arbitrary circumference around the axis of rotation Ax of the drum **124**, and the reception coil **310**. The separation distance between the reception coil **310** and the first drive module **330a** may be the same as the separation distance between the reception coil **310** and the second drive module **330b**, and the separation distance between the first drive module **330a** and the second drive module **330b** may be the same as the separation distance between the reception coil **310** and the first drive module **330a**. At this time, the weight of the first drive module **330a** and the second drive module **330b** and the weight of the reception coil **310** may be the same.

For another example, the center angle between the reception coil **310** and the first drive module **330a** may be the same as the center angle between the reception coil **310** and the second drive module **330b**. This is because the weight of the first drive module **330a** and the second drive module **330b** and the weight of the reception coil **310** are different.

Specifically, the center angle between the reception coil **310** and the first drive module **330a** may be the same as the center angle between the reception coil **310** and the second drive module **330b**, and the center angle between the first drive module **330a** and the second drive module **330b** may be the same as the center angle between the reception coil **310** and the first drive module **330a**. At this time, the weight of the first drive module **330a** and the second drive module **330b** and the weight of the reception coil **310** may be the same.

Here, the center angle between the reception coil **310** and the first drive module **330a** may be referred to as a first center angle θ_1 , the center angle between the reception coil **310** and the second drive module **330b** may be referred to as a second center angle θ_2 , and the center angle between the first drive module **330a** and the second drive module **330b** may be referred to as a third center angle θ_3 .

As shown in FIG. 6, the first center angle means an angle between a line connecting the center of the reception coil **310** and the rotation axis Ax of the drum **124**, and a line connecting the center of the first drive module **330a** and the rotation axis Ax of the drum **124**, the second center angle means an angle between a line connecting the center of the reception coil **310** and the rotation axis Ax of the drum **124**, and a line connecting the center of the second drive module **330b** and the rotation axis Ax of the drum **124**, and the third center angle means an angle between a line connecting the center of the second drive module **330b** and the rotation axis

Ax of the drum **124**, and a line connecting the center of the first drive module **330a** and the rotation axis Ax of the drum **124**.

Here, “the same” does not mean the exact same in the mathematical sense, but means that the approximation is the same within a range including an error. The first center angle, the second center angle, and the third center angle may be 119 degrees to 121 degrees.

The gear rail **350** is gear-coupled and rotated with each drive module **330**. The gear rail **350** may have a ring shape having a diameter smaller than that of the guide part **341a**.

For example, the gear rail **350** may include a ring-shaped rail body **351a**, a rack gear **351b** formed on the inner circumferential surface of the rail body **351a**, and a protrusion **351c** which is protruded from the outer circumferential surface of the rail body **351a** and restrains the balancing weight **360**.

The rack gear **351b** is formed along the inner circumferential surface of the rail body **351a**. The inner circumferential surface of the rail body **351a** means a surface relatively close to the rotation axis Ax of the drum **124** in the rail body **351a**, and the outer circumferential surface of the rail body **351a** means a surface positioned farther from the rotation axis Ax of the drum **124** than the outer circumferential surface of the rail body **351a** in the rail body **351a**. The inner circumferential surface of the rail body **351a** and the outer circumferential surface of the rail body **351a** may be disposed to face each other. The inner circumferential surface of the rail body **351a** and the outer circumferential surface of the rail body **351a** are disposed to surround the rotation shaft Ax of the drum **124**.

The gear rail **350** may be provided to correspond to the number of drive modules **330**. The gear rail **350** includes a first gear rail **351** and a second gear rail **352**. The first gear rail **351** is rotated by the driving force of the first drive module **330a**, and the second gear rail **352** is rotated by the driving force of the second drive module **330b**. The rack gear **351b** of the first gear rail **351** is engaged with the pinion gear **332** of the first drive module **330a**, and the rack gear **351b** of the second gear rail **352** is engaged with the pinion gear **332** of the second drive module **330b**.

The gear rail **350** may be accommodated in the rail accommodating part **341d**. The gear rail **350** may rotate while sliding in the rail accommodating part **341d**.

The two gear rails **350** may be positioned at different heights. The first gear rail **351** and the second gear rail **352** may be disposed to overlap in the direction of the central axis of the drum **124**. In FIG. 4, the first gear rail **351** is disposed above the second gear rail **352**.

The balancing weight **360** moves along the circumference of the drum **124** by the rotation of each gear rail **350** to change the center of gravity of the drum **124**. At least two balancing weights **360** are provided, and each balancing weight **360** is restrained by each gear rail **350**. The balancing weight **360** may include a first balancing weight **360** and a second balancing weight **360**.

The balancing weight **360** may include a balancing body **361** having a coupling groove **361a** coupled to the gear rail **350**, and a roller **362** coupled to the balancing body **361**.

The balancing body **361** may include an object having a weight or mass. The balancing body **361** has an arc shape, and a coupling groove **361a** may be formed on a surface facing the outer circumferential surface of the gear rail **350**. The protrusion **351c** of the gear rail **350** is inserted into the coupling groove **361a**. The protrusion **351c** is inserted into

the coupling groove **361a** of the balancing body **361**, so that the movement of the balancing body is constrained by the rotation of the gear rail **350**.

The roller **362** is provided in the balancing body **361** so as to be rotatable. The roller **362** is in close contact with the inner surface of the guide part **341a** and rolls. The roller **362** prevents the balancing body **361** from directly touching the inner surface of the guide part **341a**. It is preferable that a plurality of rollers **362** are provided in both ends of the balancing body **361**.

It is preferable that each drive module **330** is positioned inside an arbitrary circumference formed by the gear rail **350**, and each balancing weight **360** is positioned outside of an arbitrary circumference formed by the gear rail **350**, in terms of utilization of space.

According to the balancer and the washing machine of the present invention, there are one or more of the following effects.

First, even if the balancer rotates with the drum, a wireless power transmitter can wirelessly transmit sufficient power to the balancer in a short time.

Secondly, even if communication is not accomplished between the wireless power transmitter and the balancer that receives the power, no problem occurs in transmitting power wirelessly by controlling only the wireless power transmitter.

Third, since the balancing weight that moves actively, the drive module, and the reception coil are separated respectively, and the drive module and the balancing weight are not manufactured integrally, the manufacturing can be easily performed and the manufacturing cost can be reduced.

Fourth, since each drive module and the circuit board for controlling each drive module and supplying power are separated from each other and a single circuit board and a single reception coil are used, manufacturing cost is reduced, and the reliability is improved as the drive module does not move together with the balancing weight.

Although the exemplary embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims. Accordingly, the scope of the present invention is not construed as being limited to the described embodiments but is defined by the appended claims as well as equivalents thereto.

What is claimed is:

1. A washing machine comprising:

a tub configured to accommodate washing water;
a transmission coil that is attached to the tub and that is configured to generate a power signal to transmit power wirelessly;
a drum rotatably disposed inside the tub in a cylindrical shape and configured to accommodate laundry; and
a balancer configured to reduce unbalance of the drum caused by the laundry becoming biased toward one side of the drum during a rotation of the drum,

wherein the balancer comprises:

at least two drive modules configured to provide a driving force;
at least two gear rails that have a ring shape and that are configured to rotate while being coupled with each drive module;
at least two balancing weights configured to move along a circumference of the drum according to the rotation of the gear rails and change a center of gravity of the drum;

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- a reception coil configured to generate power from a magnetic field caused by the power signal of the transmission coil; and
 a guide case configured to accommodate at least the reception coil and the drive modules.
2. The washing machine of claim 1, wherein the drive modules comprise a first drive module and a second drive module, wherein the reception coil, the first drive module, and the second drive module are spaced apart from each other on a circumference around a rotation axis of the drum, and wherein a separation distance between the reception coil and the first drive module equals a separation distance between the reception coil and the second drive module.
3. The washing machine of claim 1, wherein the drive modules comprise a first drive module and a second drive module, wherein the reception coil, the first drive module, and the second drive module are spaced apart from each other on a circumference around a rotation axis of the drum, and wherein a center angle between the reception coil and the first drive module at a rotation axis of the drum equals a center angle between the reception coil and the second drive module at the rotation axis of the drum.
4. The washing machine of claim 1, wherein the balancer further comprises a circuit board configured to transmit power from the reception coil to the drive modules and generate a control signal for controlling the drive modules, and wherein the circuit board is accommodated in the guide case.
5. The washing machine of claim 4, wherein at least a portion of the circuit board and the reception coil are overlapped with each other in a direction of a rotation axis of the drum.
6. The washing machine of claim 1, wherein the guide case comprises a guide part configured to define a path along which the balancing weights move.
7. The washing machine of claim 6, wherein the guide part has a ring shape that corresponds to the circumference of the drum.
8. The washing machine of claim 6, wherein the guide case comprises a drive module accommodating part that extends from the guide part along a direction of a rotation axis of the drum and accommodates the drive modules.
9. The washing machine of claim 6, wherein the guide case further comprises a receiver accommodating part that extends from the guide part along a direction of a rotation axis of the drum to accommodate the reception coil.
10. The washing machine of claim 9, wherein the balancer further comprises a circuit board configured to transmit power from the reception coil to the drive modules, and generate a control signal for controlling the drive modules, and wherein the circuit board is accommodated in the receiver accommodating part.
11. The washing machine of claim 1, wherein the drive module comprises:
 a drive motor configured to generate the driving force; and
 a pinion gear that is configured to receive the driving force from the drive motor and that is engaged with the drive motor and the gear rails.

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12. The washing machine of claim 1, wherein each of the gear rails comprises:
 a rail body that has a ring shape;
 a rack gear located on an inner circumferential surface of the rail body; and
 a protrusion that protrudes toward an outer circumferential surface of the rail body and configured to restrain the balancing weights.
13. The washing machine of claim 1, wherein the at least two gear rails are located at different heights.
14. The washing machine of claim 1, wherein each of the balancing weights comprises:
 a balancing body that has a coupling groove coupled to at least one of the gear rails; and
 a roller that couples to the balancing body.
15. The washing machine of claim 1, wherein the drive modules are located at an inside circumference of the gear rails, and wherein the balancing weights are located at an outside circumference of the gear rails.
16. A balancer comprising:
 at least two drive modules configured to provide a driving force;
 at least two gear rails that have a ring shape and that are configured to rotate while being coupled with each drive module;
 at least two balancing weights configured to move along a circumference of a drum according to a rotation of the gear rails and change a gravity center of the drum;
 a reception coil configured to generate power from a magnetic field caused by a power signal of a transmission coil; and
 a guide case configured to accommodate at least the reception coil and the drive modules.
17. The balancer of claim 16, wherein the drive modules comprise a first drive module and a second drive module, wherein the reception coil, the first drive module, and the second drive module are spaced apart from each other on a circumference around a rotation axis of the drum, wherein a separation distance between the reception coil and the first drive module equals a separation distance between the reception coil and the second drive module, and wherein a separation distance between the first drive module and the second drive module equals a separation distance between the reception coil and the first drive module.
18. The balancer of claim 16, wherein the drive modules comprise a first drive module and a second drive module, wherein the reception coil, the first drive module, and the second drive module are spaced apart from each other on a circumference around a rotation axis of the drum, and wherein a center angle between the reception coil and the first drive module at a rotation axis of the drum equals a center angle between the reception coil and the second drive module at the rotation axis of the drum, and a center angle between the first drive module and the second drive module at the rotation axis of the drum equals a center angle between the reception coil and the first drive module at the rotation axis of the drum.
19. The balancer of claim 16, wherein the balancer further comprises a circuit board configured to transmit power from the reception coil to

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the drive modules and generate a control signal for controlling the drive modules, and wherein the circuit board is accommodated in the guide case.

20. The balancer of claim **19**, wherein at least a portion of the circuit board and the reception coil are overlapped with each other in a direction of a rotation axis of the drum.

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